

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

Claims 1-96 (Canceled)

96. (Previously Presented) A method of forming a virtual substrate comprising: (1) treating a surface of at least one of a device substrate and a handle substrate to allow for a possibility of formation of covalent bonds between the device substrate and the handle substrate; (2) bonding the device substrate to the handle substrate to form a bonded interface comprising covalent bonds between the device substrate and the handle substrate; and (3) removing a portion of the device substrate so as to leave a device film on the handle substrate.

97. (Previously Presented) The method of claim 96, further comprising ion implanting the device substrate prior to bonding to enable exfoliation of the device film from the device substrate by annealing the device substrate after the bonding step.

98. (Previously Presented) The method of claim 97, wherein the step of removing comprises annealing the device substrate to exfoliate the device film from the device substrate.

99. (Previously Presented) The method of claim 96, wherein the step of treating comprises at least one of passivating and cleaning.

100. (Currently Amended) The method of claim 96, wherein ~~[[a]]~~ the bonded interface between the device film and handle substrates has low resistance electrical properties.

101. (Currently Amended) The method of claim 96, wherein the bonded interface between the device film and handle substrate ~~substrates~~ has a resistivity of 3.5 ohms cm² or less.

102. (Currently Amended) The method of claim 98, further comprising [[a]] performing a post bonding thermal anneal to strengthen [[the]] a bond between the device film and handle substrate prior to performing the exfoliation anneal.

103. (Previously Presented) The method of claim 97, wherein the step of ion implanting the device substrate comprises implanting H^+ or a combination of H^+ and He^+ .

104. (Previously Presented) The method of claim 99, wherein the steps of treating the surfaces of the device and handle substrates comprises passivating the surfaces of both the device and handle substrates to allow for hydrophobic wafer bonding.

105. (Previously Presented) The method of claim 96, wherein the steps of treating the surfaces of the device and handle substrates comprises rendering the surfaces substantially hydrophobic prior to bonding.

106. (Previously Presented) The method of claim 105, wherein the steps of treating comprises treating the handle and device substrate surfaces with HF solution.

107. (Previously Presented) The method of claim 106, wherein the HF solution reduces or eliminates oxides on the handle and device substrate surfaces.

108. (Previously Presented) The method of claim 96, wherein the step of treating comprises eliminating adsorbed water on the surface of at least one of the device substrate and the handle substrate by exposure of the surface to an inert atmosphere or vacuum prior to bonding.

109. (Previously Presented) The method of claim 108, wherein eliminating adsorbed water comprises baking at a temperature such that a vapor pressure of water on at least one substrate surface is above a partial pressure of water in the surrounding environment.

110. (Currently Amended) The method of claim 96, wherein the device film comprises a Ge, a Group II-VI, a Group ~~III-V~~ III-V or a SiC semiconductor material and the handle substrate comprises a Si or a GaAs substrate.

111. (New) A method of forming a virtual substrate comprising: (1) treating a surface of at least one of a device substrate and a handle substrate to allow for a possibility of formation of a low resistance electrical contact between the device substrate and the handle substrate; (2) bonding the device substrate to the handle substrate to form a bonded interface having low resistance electrical properties between the device substrate and the handle substrate; and (3) removing a portion of the device substrate so as to leave a device film on the handle substrate.

112. (New) The method of claim 111, further comprising ion implanting the device substrate prior to bonding to enable exfoliation of the device film from the device substrate by annealing the device substrate after the bonding step.

113. (New) The method of claim 112, wherein the step of removing comprises annealing the device substrate to exfoliate the device film from the device substrate.

114. (New) The method of claim 111, wherein the step of treating comprises at least of one of passivating and cleaning.

115. (New) The method of claim 111, wherein the bonded interface between the device film and handle substrates comprises covalent bonds between the device substrate and the handle substrate.

116. (New) The method of claim 111, wherein the bonded interface between the device film and handle substrate has a resistivity of 3.5 ohms cm^2 or less.

117. (New) The method of claim 113, further comprising performing a post bonding thermal anneal to strengthen a bond between the device film and handle substrate prior to performing the exfoliation anneal.

118. (New) The method of claim 112, wherein the step of ion implanting the device substrate comprises implanting H^+ , He^+ , or a combination of H^+ and He^+ .

119. (New) The method of claim 114, wherein the steps of treating the surfaces of the device and handle substrates comprises passivating the surfaces of both the device and handle substrates to allow for hydrophobic wafer bonding.
120. (New) The method of claim 111, wherein the steps of treating the surfaces of the device and handle substrates comprises rendering the surfaces substantially hydrophobic prior to bonding.
121. (New) The method of claim 120, wherein the steps of treating comprises treating the handle and device substrate surfaces with HF solution.
122. (New) The method of claim 121, wherein the HF solution reduces or eliminates oxides on the handle and device substrate surfaces.
123. (New) The method of claim 111, wherein the step of treating comprises eliminating adsorbed water on the surface of at least one of the device substrate and the handle substrate by exposure of the surface to an inert atmosphere or vacuum prior to bonding.
124. (New) The method of claim 123, wherein eliminating adsorbed water comprises baking at a temperature such that a vapor pressure of water on at least one substrate surface is above a partial pressure of water in the surrounding environment.
125. (New) The method of claim 111, wherein the device film comprises a Ge, a Group II-VI, a Group III/V or a SiC semiconductor material and the handle substrate comprises a Si or a GaAs substrate.
126. (New) The method of claim 111, wherein the device film comprises a Group III-V film.
127. (New) The method of claim 111, wherein the bonded interface has a resistance of 35 ohms or less over a 0.1 cm² evaluation area.
128. (New) The method of claim 111, wherein the bonded interface exhibits ohmic characteristics.

129. (New). The method of claim 111, further comprising forming a strain compensation layer on a back surface of the handle substrate prior to bonding a front surface of the handle substrate to the device substrate.

130. (New) The method of claim 129, wherein a coefficient of thermal expansion (CTE) difference between the strain compensation layer and the handle substrate is of a same sign as a CTE difference between the device film and the handle substrate, and at least one strain compensation layer property is selected to control a bow of the virtual substrate over a given temperature range.

131. (New) The method of claim 130, wherein the step of bonding occurs at an elevated temperature to reduce the bow of the virtual substrate at elevated temperatures.

132. (New) The method of claim 111, further comprising epitaxially growing at least one semiconductor layer on the device film and forming a semiconductor device comprising the at least one semiconductor layer.